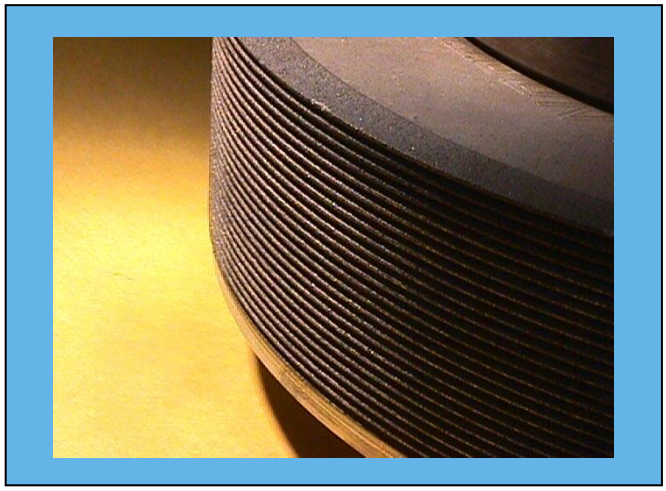
Innovations in Precision Grinding of Hard Alloys

Background

Hardened tool steel components with complex geometric features such as fine-pitch threads or serrations present a significant manufacturing challenge to the automotive industry. Grinding is the only cost-effective method to produce such features; but, before grinding can begin, the wheel must be shaped into a mirror image of the part. This shaping process is called truing. Not only is truing time consuming, but it removes material from the grinding wheel, shortening its life.

Alumina grinding wheels are in common use, but they wear excessively on hard steels and must frequently be re-trued. Norton Abrasives, a division of St. Gobain, recently introduced a metal bonded, conductive super-abrasive wheel (Sceptre™) that offers the opportunity to use wire electro-discharge machining (EDM) to shape the wheel instead of abrasive truing.

The K. O. Lee Company, one of the only remaining creep-feed grinder manufacturers in the United States, approached the Oak Ridge National Laboratory (ORNL) to help develop an innovative EDM method to form serrated forms on super-abrasive grinding wheels used for hard steel alloys.



Detail view of a metal-bonded grinding wheel showing wire EDM grooves

Benefits

- New method to grind complex shapes in hard steel demonstrated
- Higher productivity and reduced wastage of grinding wheels
- Multi-party collaboration (government, industry, university) promotes technology development
- New technology for a U.S. machine tool maker

The Technology

The K. O. Lee Company engineers collaborated with ORNL's High Temperature Materials Laboratory (HTML) Machining, Inspection, and Tribology User Center staff in the effort. A state-of-the-art cubic boron nitride grinding wheel was provided by Norton Abrasives for use in the project.

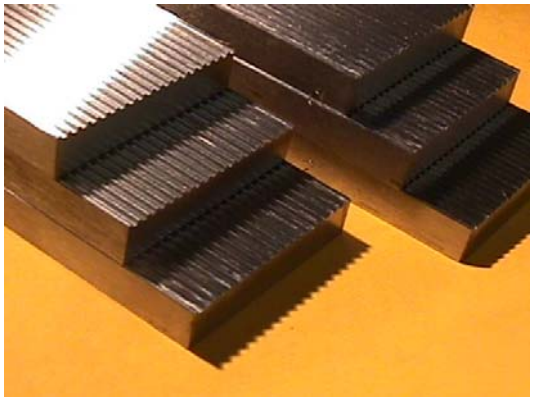
Using a variable-speed motorized spindle provided by Professor Albert Shih, University of Michigan, a modified EDM machine in Oak Ridge was used to form serrations in the grinding wheel. The formed wheel was then used to creep-feed grind coupons of hardened steel, successfully demonstrating the new method for precision grinding of complex shapes in hard alloys.

Commercialization

The feasibility of the new method to form complex shapes in hard alloys was demonstrated under the HTML User Program.

The next step toward commercialization is to conduct a detailed analysis of the process costs when scaled to production volumes. Optimization of process parameters, part handling, fixturing, and automation still remain to be addressed.

The K. O. Lee Company has added a new technology to its portfolio, and Norton Abrasives has found a potential new market for its metal-bonded super-abrasive grinding wheels. Applications in automotive and truck parts manufacturing are only one potential use for fine-pitch thread form super-abrasive creep-feed grinding technology. Introduction of this innovative technology is expected in the near future, pending the completion of follow-on tests and cost analysis.



Bearing steel coupons with precision grooves produced by the new process

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Printed on recycled paper

March 2005